



National Airspace System (NAS)
Open System Interconnection (OSI)
Directory Services

FAA-STD-044
October 23, 1992

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FAA-STD-044
October 23, 1992

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FOREWORD

This standard establishes the Directory Services requirements for National Airspace System (NAS) open end-systems. The requirements specified herein are consistent with the International Organization for Standardization (ISO) Directory Services standards and the related Open Systems Environment (OSE) Implementors Workshop (OIW) Stable Implementation Agreements for Open Systems Interconnection (OSI) Protocols.

This standard includes definitions in Paragraph 6.1.

FAA-STD-044
October 23, 1992

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TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
1.	SCOPE	1
1.1	Scope	1
1.2	Purpose	1
2.	APPLICABLE DOCUMENTS	3
2.1	Government Documents	3
2.2	Non-government Documents	3
3.	REQUIREMENTS	5
3.1	General Requirements	5
3.2	NAS User and Application Process Requirements	7
3.2.1	Local Directory Requirements	7
3.2.1.1	Application Title Directory	7
3.2.1.2	Network Address Directory	7
3.2.2	NAS Directory Information Base	7
3.2.3	Directory User Agent Application Process	7
3.2.4	Directory System Agent Application Process	8
3.3	Directory Service Requirements	9
3.3.1	Directory Bind and Unbind Operations	9
3.3.2	"White Pages" Capability	9
3.3.3	"Yellow Pages" Capability	9
3.3.4	Group Listing	10
3.3.5	Authentication	10
3.3.6	Abandon Operation	10
3.3.7	Directory Modify Operations	10
3.3.8	Service Controls	10
3.3.9	Error Reporting	10
3.3.10	Service Control Considerations	10
3.4	Distributed Directory Operations	10
3.4.1	DSA Bind and Unbind Operations	11
3.4.2	Usage of Chaining Arguments and Chaining Results	11
3.4.3	Authentication	11
3.4.4	Service Controls	11
3.4.5	Trace Information	11
3.4.6	Error Reporting - Detection of Search Loop	11
3.4.7	Options and Constraints	11
3.4.7.1	Priority Service Control	11
3.4.7.2	Application Protocol Data Unit (APDU) Size Considerations	11
3.4.7.3	Filters	11
3.5	Directory Protocol Requirements	12

TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
3.5.1	Directory Access Protocol	12
3.5.2	Directory System Protocol	12
3.5.3	Use of Other Services	12
3.5.3.1	Application Layers	12
3.5.3.1.1	Remote Operations Service Element	12
3.5.3.1.2	Association Control Service Element	12
3.5.3.2	Presentation Layer	12
3.5.3.3	Session Layer	12
3.6	Directory Security Requirements	12
3.7	Directory Management and Administration Requirements	13
3.7.1	Schema Management	13
3.7.1.1	Name Recognition	13
3.7.1.2	Directory Information Tree (DIT) Name Bindings	13
3.7.1.3	Object Classes	13
3.7.1.4	Attributes Values and Syntaxes	13
3.7.1.5	Matching Rules	14
3.7.2	Knowledge Management	14
3.7.2.1	Superior References	14
3.7.2.2	Subordinate References	14
3.7.2.3	Cross References	14
3.7.2.4	Non-specific Subordinate References	14
4.	QUALITY ASSURANCE PROVISIONS	15
5.	PREPARATION FOR DELIVERY	17
6.	NOTES	19
6.1	Definitions	19
6.1.1	ISO Reference Model Definitions	19
6.1.2	ISO Directory Standard Definitions	19
6.2	Acronyms and abbreviations	20

LIST OF FIGURES

Figure 3.1	NAS Directory System Architecture	6
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1. SCOPE

1.1 Scope. This standard establishes the requirements for the implementation of Open Systems Interconnection (OSI) directory service capabilities within Federal Aviation Administration (FAA) National Airspace System (NAS) open end-systems. It also establishes requirements for a NAS directory information base (NDIB).

1.2 Purpose. This document establishes the requirements that will ensure a standardized method for accessing, storing, and updating information in a common NAS directory.

FAA-STD-044
October 23, 1992

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2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents form a part of this standard to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this standard, the contents of this standard shall be considered the superseding requirement.

FAA Standards

FAA-STD-042

NAS OSI Naming and Addressing

National Institute of Standards and Technology (NIST)

NIST SP-500-206

Stable Implementation Agreements for Open Systems
Interconnection Protocols, December 1992

2.2 Non-government Documents. The following documents form a part of this standard to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this standard, the contents of this standard shall be considered the superseding requirement.

International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC)

ISO/IEC 7498-3:1989

Information Processing Systems – Open Systems
Interconnection – Basic Reference Model – Part 3: Naming
and Addressing, 1st Edition

ISO 8326:1987

Information Processing Systems – Open Systems
Interconnection – Basic Connection Oriented Session
Service Definition, 1st Edition

ISO 8326:1987/AD2:1988

Information Processing Systems – Open Systems
Interconnection – Basic Connection Oriented Session
Service Definition – Addendum 2: Incorporation of
Unlimited User Data

ISO 8649:1988

Information Processing Systems – Open Systems
Interconnection – Definition for the Association Control
Service Element, 1st Edition

ISO 8650:1988

Information Processing Systems – Open Systems
Interconnection – Protocol Specification for the Association
Control Service Element, 1st Edition

ISO 8822:1988

Information Processing Systems – Open Systems
Interconnection – Connection Oriented Presentation Service
Definition, 1st Edition

ISO 8825:1987

Information Processing Systems – Open Systems
Interconnection – Specification of Basic Encoding Rules for
Abstract Syntax Notation One (ASN.1), 1st Edition

ISO/IEC 9072-1:1989	Information Processing Systems – Text Communication – Remote Operations – Part 1: Model, Notation, and Service Definition, 1st Edition
ISO/IEC 9072-2:1989	Information Processing Systems – Text Communication – Remote Operations – Part 2: Protocol Specification, 1st Edition
ISO/IEC 9594-1:1990	Information Technology – Open Systems Interconnection – The Directory – Part 1: Overview of Concepts, Models, and Services, 1st Edition
ISO/IEC 9594-2:1990	Information Technology – Open Systems Interconnection – The Directory – Part 2: Models, 1st Edition
ISO/IEC 9594-3:1990	Information Technology – Open Systems Interconnection – The Directory – Part 3: Abstract Service Definition, 1st Edition
ISO/IEC 9594-4:1990	Information Technology – Open Systems Interconnection – The Directory – Part 4: Procedures for Distributed Operations, 1st Edition
ISO/IEC 9594-5:1990	Information Technology – Open Systems Interconnection – The Directory – Part 5: Protocol Specifications, 1st Edition
ISO/IEC 9594-6:1990	Information Technology – Open Systems Interconnection – The Directory – Part 6: Selected Attribute Types, 1st Edition
ISO/IEC 9594-7:1990	Information Technology – Open Systems Interconnection – The Directory – Part 7: Selected Object Classes, 1st Edition
ISO/IEC 9594-8:1990	Information Technology – Open Systems Interconnection – The Directory – Part 8: Authentication Framework, 1st Edition

3. REQUIREMENTS

3.1 General Requirements. This standard establishes the requirements for a NAS OSI compliant directory system. NAS open end-systems requiring a directory system function shall comply with the requirements herein.

The NAS Directory System shall comprise a NAS directory information base (NDIB), directory user agent (DUA) application processes, directory system agent (DSA) application processes as well as the directory access protocol (DAP) and the directory system protocol (DSP) (see Figure 3.1). Directory application processes and ISO directory protocols shall be in accordance with the requirements specified in this standard. The directory protocols shall reside in the application layer (i.e., layer 7) of the NAS OSI architecture.

NAS open end-systems (i.e., NAS processing systems using OSI protocols) using the NAS Directory System shall implement a directory user agent (DUA) application process to enable users (i.e., humans or application processes) access to the NAS directory information base (NDIB). NAS open end-systems that contain part of the NAS Directory Information Base (NDIB) shall implement a directory system agent (DSA).

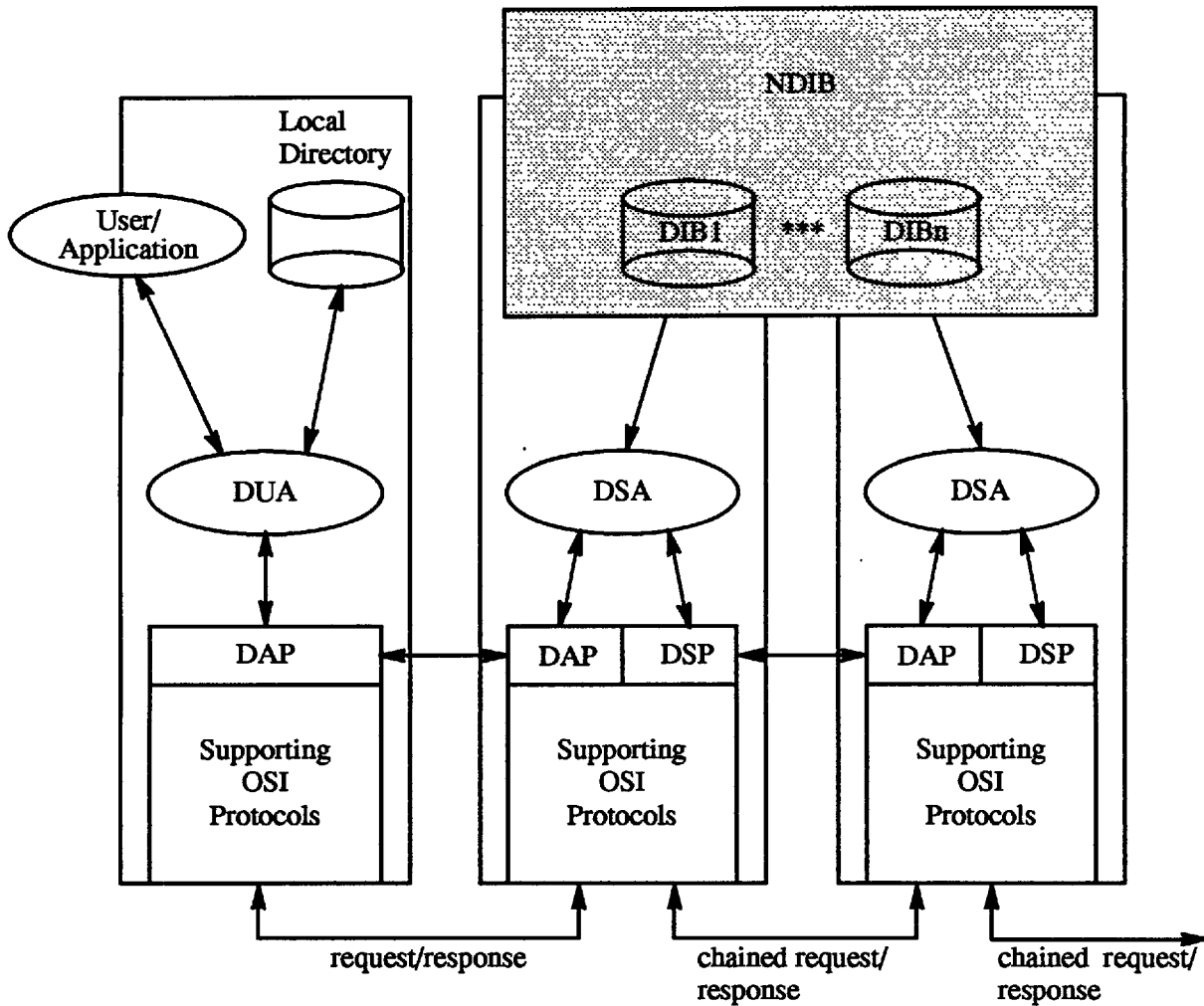


Figure 3.1 NAS Directory System Architecture

3.2 NAS User and Application Process Requirements.

3.2.1 Local Directory Requirements. The use of local directories will facilitate communication between open end-systems by storing OSI addresses necessary for communication. Each open end-system shall provide two local directories: an application title directory and a network address directory as defined in ISO 7498-3, Basic Reference Model - Part 3: Naming and Addressing.

The local directory may be used as a general-purpose communications directory into which entries belonging to the object classes, specified in FAA-STD-042: NAS OSI Naming and Addressing, may be accessed or stored.

3.2.1.1 Application Title Directory. The application title directory shall provide a mapping between an Application-Process-Title and a presentation address or an Application-Entity-Title and a presentation address. The presentation address shall contain the:

- a. presentation selector (PSEL),
- b. session selector (SSEL),
- c. transport selector (TSEL), and
- d. one or more network service access point (NSAP) addresses.

The application title directory shall support both primitive and descriptive Application-Process-Titles and Application-Entity-Titles. A name resolver shall map the descriptive name of an Application-Process/Application Entity into a primitive name.

3.2.1.2 Network Address Directory. The network address directory shall provide a mapping between NSAP address(es) and sub-network point of attachment (SNPA) address(es).

3.2.2 NAS Directory Information Base. The NAS Directory Information Base (NDIB) shall provide directory users access to information about NAS objects. If the NDIB is distributed across multiple DSAs, each open end-system containing a DSA shall contain a segment of the NDIB and provide access points to the overall NDIB.

The NDIB shall be capable of supporting the object classes, attribute types, and syntaxes defined in FAA-STD-042: NAS OSI Naming and Addressing as well as those defined in the NIST SP-500-202: Stable Implementation Agreements for OSI Protocols.

3.2.3 Directory User Agent Application Process. NAS open end-systems using the NAS Directory System shall contain a directory user agent (DUA) application process. The DUA shall provide the capability for users to access the NDIB (see Figure 3.1). A DUA shall represent only one directory user in a particular instance of communications. However, a DUA shall be capable of maintaining multiple user dialogues with the directory at one time.

The DUA shall be capable of accessing external DSAs. The DUA shall support the directory service requirements defined in Paragraph 3.3 and the directory access protocol (DAP) as defined in Paragraph 3.5.1.

The purpose of the DUA is to:

- a. Isolate the NAS OSI user from directory changes:
 - (1) Resulting from various communication objects, singly or jointly in groups, entering and leaving the network without warning.
 - (2) Resulting from the addition or removal of paths between the communication objects, especially NAS OSI network nodes.
 - (3) Resulting from change of addresses, availability, and physical locations and other characteristics of the communication objects.
- b. Provide the mapping between the formal and informal names of the NAS communications objects.
- c. Facilitate user ability to access, store, and update information in the NDIB.
- d. Allow authorized users to obtain information about the NAS OSI environment.
- e. Facilitate the maintenance and administration of information in the NDIB.

3.2.4 Directory System Agent Application Process. NAS open end-systems that contain part of the NDIB shall also contain a directory system agent (DSA) application process. The DSA shall be capable of supporting multiple application associations, accessing the NDIB to process user requests from the DUA, and interacting with remote DUAs.

The DSA shall support the distributed operation requirements in Paragraph 3.4, the security requirements in Paragraph 3.6, and the management requirements in Paragraph 3.7. The DSA shall also support the directory system protocol (DSP) as defined in Paragraph 3.5.2.

The following features shall be supported in the DSA:

- a. **Directory Interrogation Operations**
 - (1) Read
 - (2) Compare
 - (3) List
 - (4) Search
 - (5) Abandon
- b. **Directory Modification Operations**
 - (1) Add Entry
 - (2) Remove Entry
 - (3) Modify Entry
 - (4) Modify Relative Distinguished Name
- c. **Directory Responses**

- d. Error Responses
- e. Referrals
- f. Chaining of Directory Requests
- g. Service Controls
 - (1) Time for processing of requests
 - (2) Size of requests
 - (3) Scope of searches
 - (4) Priority of requests

3.3 Directory Service Requirements. The DUA shall allow the user to interrogate, retrieve, and modify the information in the NDIB by providing the operations and error recovery procedures defined in ISO/IEC 9594-3, The Directory - Part 3: Abstract Service Definition, and as defined in the following paragraphs.

3.3.1 Directory Bind and Unbind Operations. The DUA shall provide for Bind and Unbind operations for use at the beginning and end of a particular period of accessing the NDIB.

3.3.2 "White Pages" Capability. The DUA shall provide a "White Pages" style of service, wherein Application Entities, Organizational Units, Organizational Persons, and other objects may be viewed through the perspective of their organizational hierarchy.

The DUA shall provide Read and Compare operations to enable and facilitate the "White Pages" capability. The Read operation shall allow users who have foreknowledge of the Distinguished Name of an entry to perform "exact match" lookups and retrieve selected attributes from directory entries. The Compare operation will allow users to present a purported value to the directory and test for its existence within an entry.

The DUA shall provide a "White Pages" browsing capability using the List and Search operations in conjunction with the Read operation. When the directory user is unable to supply the exact Distinguished Name, the browsing capability shall enable the user to browse through the NDIB for objects of interest. The user shall be able to list all the subordinate entries of an object, apply search filters to select groups of entries at the current level of scrutiny, and apply search filters to select groups of entries within the entire subtree.

The DUA shall provide the capability to view the directory information from a "White Pages" perspective to facilitate the modification of information using the Add Entry, Remove Entry, Modify Entry, and Modify RDN operations as well as provide for the storing of Alias entries, where appropriate.

3.3.3 "Yellow Pages" Capability. The DUA shall provide a "Yellow Pages" capability so that objects may be viewed by organizational function. The DUA shall provide the capability to search for entries by object class identifier, thus allowing for the retrieval of all Application Entities within a particular scope of search.

The DUA shall provide the capability to view the directory information from a "Yellow Pages" perspective to facilitate the modification of information using the Add Entry, Remove Entry, Modify Entry, and Modify Relative Distinguished Name (RDN) operations. It shall enable users to create Organization Role entries at their discretion.

3.3.4 Group Listing. The DUA shall enable users determine whether or not a particular object is a member of a group of objects by means of the Compare operation. It shall also provide the capability to list all the members in a group. This capability is known as "group", "distribution list", or "name-to-set-of-names mapping" and may be approached from either a "White Pages" or "Yellow Pages" view.

3.3.5 Authentication. The DUA shall provide authentication (see Paragraph 3.6).

3.3.6 Abandon Operation. The DUA shall provide the ability for the user to abandon interrogation operations if the directory user is no longer interested in continuing.

3.3.7 Directory Modify Operations. The DUA shall provide four directory modify operations: Add Entry, Remove Entry, Modify Entry and Modify RDN.

3.3.8 Service Controls. The DUA shall provide the service controls specified in ISO/IEC 9594-3, The Directory - Part 3: Abstract Service Definition, to direct or constrain the provision of service. Such service controls include:

- a. preference or prohibition of chaining
- b. limiting the scope of an operation to the specified DSA or directory management domain (DMD)
- c. limiting the maximum number of objects to be returned in List and Search operation results
- d. limiting the elapsed time (in seconds) within which an operation should be provided
- e. limiting the scope of Referrals
- f. enabling or disabling the use of copied Directory Information
- g. enabling or disabling the dereferencing of aliases
- h. specifying the priority of an operation

3.3.9 Error Reporting. The DUA shall be able to return errors. The error responses shall report outcomes due to problems encountered in performing an operation.

3.3.10 Service Control Considerations. The DUAs shall supply default values for service control parameters. Default values shall be settable.

3.4 Distributed Directory Operations. DSA distributed directory operations shall be implemented as specified in ISO/IEC 9594, Part 4: The Directory - Procedures for Distributed Operations and this standard.

The DSAs shall provide the Read, Search and Modify operations as well as their distributed versions (Chained Read, Chained Search, and Chained Modify) to allow propagation of requests for those services to other DSAs.

The DSAs supporting distributed operations and chaining shall fully support the Directory System Protocol (DSP). The DSAs supporting distributed operations shall accept incoming DSP associations and invocations. DSAs shall handle at least 64 simultaneous associations.

The DSAs supporting chaining shall support loop detection and loop avoidance. In chaining and multicasting operations, there shall be no alteration in the primitive content of the original Directory Access Protocol (DAP) supplied invocation except during request decomposition.

3.4.1 DSA Bind and Unbind Operations. The DSA shall provide the DSA Bind operation for use by the DSA to bind its chained Read, chained Search, and chained Modify operation to those of another DSA.

Likewise, the DSA shall provide the DSA Unbind operation for use by a DSA for release of the connection.

3.4.2 Usage of Chaining Arguments and Chaining Results. Chaining Arguments and Chaining Results shall be generated and accepted.

3.4.3 Authentication. The DSA shall provide authentication (see Paragraph 3.6).

3.4.4 Service Controls. A DSA that has chained a request shall act upon any referrals it receives rather than returning them to the requestor if the prefer Chaining service control is present.

3.4.5 Trace Information. If the propagation of a Search operation involves the creation of a new Search, the trace information shall not be reset, but the full trace information for the overall Search operation to the point where the new Search was generated shall be included in the new Search.

3.4.6 Error Reporting – Detection of Search Loop. The DSA shall detect search looping situations caused by aliases using the algorithm specified in NIST SP-500-202: Stable Implementors Agreements for OSI Protocols, Clause 7.2.3 – Part 11, or an equivalent technique that accomplishes the same result.

3.4.7 Options and Constraints. The DSA shall be subject to the following options and constraints.

3.4.7.1 Priority Service Control. The DSA shall use the Priority Service Control Parameter in accordance with the logical model provided in NIST SP-500-202: Stable Implementation Agreements for OSI Protocols, Clause 7.1.4 – Part 11.

3.4.7.2 Application Protocol Data Unit (APDU) Size Considerations. The DSA shall accept invoke APDUs and return-result APDUs unless they exceed 32767 octets in size. If they exceed the limits, they shall be discarded and an “unwillingToPerform” error shall be returned.

3.4.7.3 Filters. All filtering operations defined in the ISO/IEC 9594-3, The Directory – Part 3: Abstract Service Definition, shall be supported.

DSAs shall support, at least, 8 nested "Filter" parameters, and a total limit of 32 Filter Items. When these limits are exceeded, the recipient of that SearchArgument shall return the Service Problem "unwilling To Perform".

3.5 Directory Protocol Requirements. The NAS Directory System shall implement the functionality specified in the ISO/IEC 9594-5, Part 5: The Directory - Protocol Specifications, and in the following paragraphs.

3.5.1 Directory Access Protocol. NAS open end-systems using the NAS Directory System shall implement the directory access protocol (DAP) to enable directory access services. The DAP shall comprise the following Application Service Elements (ASE): read ASE, search ASE, and modify ASE corresponding to read Port, search Port, and modify Port respectively. The Application Context shall identify these ASEs.

3.5.2 Directory System Protocol. NAS open end-systems that maintain part of the NDIB shall implement the directory system protocol (DSP) to enable distributed directory operations. The DSP shall comprise the following ASEs: chained Read ASE, chained Search ASE and chained Modify ASE corresponding to chained Read Port, chained Search Port and chained Modify Port. The Application Context shall identify these ASEs.

3.5.3 Use of Other Services. NAS open end-systems providing OSI directory service capabilities shall implement the underlying services defined in the following paragraphs to enable support for the directory service protocols. These services are subject to constraints specified herein.

3.5.3.1 Application Layers.

3.5.3.1.1 Remote Operations Service Element. The directory ASEs shall use RO-INVOKE, RO-RESULT, RO-ERROR, RO-REJECT-U and RO-REJECT-P services of ISO/IEC 9072-1, Remote Operations Service Element(ROSE) - Part 1: Model, Notation, and Service Definition. Operation class 2 shall be supported in order to support the Abandon operation.

3.5.3.1.2 Association Control Service Element. The A-ABORT service defined in ISO 8649, Service Definition for the Association Control Service Element (ACSE), shall be used by association-accepting DSAs to escape unwanted associations, which, under ISO/IEC 9072-2, ROSE - Part 2: Protocol Specification, cannot be released.

3.5.3.2 Presentation Layer. The Presentation Layer shall provide the Kernel Functional Unit as defined in ISO 8822, Connection Oriented Presentation Service Definition, and support at least two presentation contexts. It shall provide transfer syntax defined by the ISO 8825, Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).

3.5.3.3 Session Layer. The Session Layer Service shall provide Kernel and Duplex Functional Units in accordance with ISO 8326, Basic Connection Service Definition. "Unlimited user data", as defined in ISO 8326/AD 2, Basic Connection Oriented Session Service Definition - Addendum 2: Incorporation of Unlimited User Data, shall be supported.

3.6 Directory Security Requirements. Authentication shall be provided in accordance with ISO/IEC 9594-8 Information Technology - Open Systems Interconnection - The Directory - Part 8: Authentication Framework.

October 23, 1992

3.7 Directory Management and Administration Requirements. The NAS Directory System shall provide the features and capabilities described in the following paragraphs subject to the ISO/IEC 9594, Part 4: Procedures for Distributed Operations, Part 6: Selected Attribute Types, and Part 7: Selected Object Classes. The NAS directory system shall provide for the following directory management and administration utilities:

- a. Configuration utilities (e.g., database initialization, number of concurrent associations, administrative limits, etc.)
- b. Management and administration (e.g., installation, backup, inspection and dump, directory data loading, error reporting, database restore utilities, startup, cache lifetime timers and other caching criteria, shutdown and recovery, operation monitoring, etc.)
- c. Logging of both recoverable and non-recoverable events
- d. Knowledge management, including superior, subordinate, non-specific subordinate, and cross references
- e. Security management (security policy parameters, access control list, logging of authentication failures, bind failures, etc.)
- f. User management (usage logging, including bind and operation requests and outcomes)

3.7.1 Schema Management. The DUAs and DSAs shall include the necessary management utilities for the creation and maintenance of new Object Classes, Structure Rules, Name Bindings, Attribute Types and Attribute Syntaxes.

3.7.1.1 Name Recognition. The DSA shall be capable of recognizing the attributes specified in a Relative Distinguished Name (RDN) within the valid Naming Contexts. NAS users shall have the facility to configure the Context Prefix of each Naming Context the DSA is to contain. The DSA shall be capable of being reconfigured to recognize any other attribute as part of a valid Context Prefix within the DSA.

3.7.1.2 Directory Information Tree (DIT) Name Bindings. The DSA shall provide the capability to specify and configure new DIT name bindings, including the capability for extended nesting of recursive DIT name bindings. Structure rules associated with superclass should be adopted wherever suitable.

3.7.1.3 Object Classes. The DSAs shall provide for specifying and configuring new object classes when no appropriate object class is available and when no standardized object classes and attributes can fulfill the requirements.

The creation of subclasses, both registered and unregistered, utilizing single inheritance or multiple inheritance with auxiliary object classes shall be supported.

3.7.1.4 Attributes Values and Syntaxes. Both the DUAs and DSAs shall have the capability to specify and configure new attribute types. The DSAs shall provide appropriate user interface facilities to allow such attribute values to be specified and presented.

The DSAs and DUAs shall provide capabilities for the specification of further attribute syntaxes. A new attribute type may be defined only when no appropriate attributes are available and no standardized attributes can fulfill the requirements. The attribute macro as defined in ISO/IEC 9594-2, The Directory - Part 2: Models, may be used to define new attributes.

3.7.1.5 Matching Rules. DSAs shall observe the matching rules.

3.7.2 Knowledge Management. All DSAs shall provide means of configuring the knowledge reference types mentioned in the sub-paragraphs below. The NAS directory implementations shall provide utilities to check the consistency of knowledge between DSAs in the NAS. DSAs shall be capable of requesting and obtaining cross references to improve performance. Procedures shall be defined to correct erroneous knowledge or apprise the user of a problem when the error code "Invalid Reference" is returned from remote DSAs.

3.7.2.1 Superior References. The Superior Reference shall consist of the Access Point of a DSA. Each non-first Level DSA shall maintain precisely one Superior Reference which shall form part of a reference path to the root.

3.7.2.2 Subordinate References. The Subordinate Reference shall consist of an RDN corresponding to an immediate subordinate DIB entry and the Access Point of the DSA to which the Administrative Authority for that entry was delegated.

3.7.2.3 Cross References. A Cross Reference shall consist of a Context Prefix and the Access Point of a DSA.

3.7.2.4 Non-specific Subordinate References. A Non-Specific subordinate reference shall consist of the Access Point of a DSA which holds one or more immediately subordinate Naming Contexts.

4. QUALITY ASSURANCE PROVISIONS

This paragraph is not applicable to this standard.

FAA-STD-044
October 23, 1992

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5. PREPARATION FOR DELIVERY

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FAA-STD-044
October 23, 1992

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6. NOTES

6.1 Definitions.

6.1.1 ISO Reference Model Definitions. This standard uses the following terms defined in ISO 7498-3:

- a. abstract-syntax
- b. application-context
- c. application-entity
- d. application entity title
- e. application layer
- f. application-process

6.1.2 ISO Directory Standard Definitions. This standard uses the following terms defined in ISO/IEC 9594-1:

- a. directory
- b. directory information base
- c. directory user

This standard uses the following terms defined in ISO/IEC 9594-2:

- a. access point
- b. administrative authority
- c. directory management domain
- d. directory system agent
- e. directory user agent
- f. object
- g. object class

This standard uses the following terms defined in ISO/IEC 9594-3:

- a. filter
- b. result
- c. service controls

This standard uses the following terms defined in ISO/IEC 9594-4:

- a. chaining
- b. context prefix
- c. cross reference
- d. DIB fragment

- e. naming context
- f. referral
- g. subordinate reference
- h. superior reference

6.2 Acronyms and abbreviations.

ACSE	association control service element
APDU	application protocol data unit
ASE	application service element
ASN.1	abstract syntax notation one
DAP	directory access protocol
DIB	directory information base
DIT	directory information tree
DMD	directory management domain
DSP	directory system protocol
DSA	directory system agent
DUA	directory user agent
FAA	Federal Aviation Administration
ISO	International Organization for Standardization
NAS	National Airspace System
NDIB	NAS directory information base
NIST	National Institute of Standards and Technology
NSAP	network service access point
OSE	Open Systems Environment
OSI	Open Systems Interconnection
OIW	OSE Implementors Workshop
RDN	relative distinguished name
ROSE	remote operations service element
SNPA	sub-network point of attachment